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SPECIFICATION

FLUID, ~~POWDER OR GRAIN~~ FEED TANK

Field of the technology

This invention relates to a fluid, powder or grain feed tank.

Background technologies

Conventional systems of liquid feeding, which successively decrease the liquids that had been filled with in a tank, cannot keep the liquids away from contacting air while the liquid level drops. When the liquid filled with in the tank is a reducing liquid such as sodium sulfite, the liquid may face a problem of deterioration due to oxidation leading to compromising its commercial value.

Though a system is designed to control the quantity of a chemical in a chemical tank by means of providing a chemical manufacturing facility separately, particularly in case the chemical must be continuously sent out, it is typical in actuality that additional chemical is fed into the chemical tank after a level gauge indicates that the level in the chemical tank has dropped. Also in this case, the surface of the chemical contacts air when the level drops, leading to the said problem of deterioration due to oxidation.

This kind of problem is not limited to the case where tanks are filled with liquid, but is commonly observed in the cases where tanks are filled with gas, powder, or granules.

In addition, there is another problem: the more frequently fillers contact air, the more likely foreign matters such as wastes, vermin, or bacteria may invade into the fillers.

This invention is intended to provide a fluid, powder or grain feed tank that does not allow its fillers to be deteriorated of oxidation, deteriorated of oxidation even when a consecutive feeding system is applied, and furthermore does not allow foreign matters to invade into the fillers.

Disclosure of the invention

The tank of this invention is provided with a tank body to be filled with fluid, powder, or grain, the inside of which is divided into two chambers with a separating wall, which is movable so as to relatively increase and/or decrease the volumes of the said two chambers, each of which is filled with

the said fluid, powder, or granules.

The inside of the said tank body is divided horizontally to form an upper chamber and a lower chamber with a separating wall, which is movable up and down.

Or, otherwise, the inside of the said tank body is divided vertically to form a left chamber and a right chamber with a separating wall, which is movable from side to side.

The said separating wall comprises a base plate of multi-angular or round form and a slidable sheet: the one end of the said slidable sheet is fixed on a peripheral end of the said base plate, and the other end of the said slidable sheet is fixed on the inside walls of the tank body.

Or, otherwise, the inside of the said tank body is divided with a separating wall installed on a plurality of pillars extending upward and downward into an inner chamber inside the said separating wall and an outer chamber outside the said separating wall, the separating wall located in the spans of the pillars being movable toward the inner chamber as well as toward the outer chamber within the tank body.

The said two chambers are filled with the same kind of fluid, powder, or grain.

Brief description of the drawings

Figure 1 is a front schematic sectional drawing showing an embodiment of the fluid, powder or grain feed tank according to this invention.

Figure 2 is a front schematic sectional drawing showing another embodiment of the fluid, powder or grain feed tank according to this invention.

Figure 3 (a) is a cross-sectional view showing a third embodiment of the fluid, powder or grain feed tank according to this invention, and Figure 3 (b) is a longitudinal sectional view of Figure 3 (a) taken along the line b – b.

Figure 4 is a cross-sectional view showing another state of the fluid, powder or grain feed tank.

Figure 5 (a) and (b) are cross-sectional views showing a fourth embodiment of the fluid, powder or grain feed tank.

Figure 6 (a) and (b) are cross-sectional views showing a fifth embodiment of the fluid, powder or grain feed tank.

Figure 7 is a sectional view showing an embodiment of the fluid, powder

or grain feed tank applied to a cargo ship according to this invention.

Best modes for carrying out the invention

The embodiments of this invention are described according to the drawings as follows:

Numeral 1 as shown in Figure 1 is the tank body for feeding fluid, powder, or grain.

The tank body 1 is designed to be filled inside with fluids including liquid or gas, powders such as flour, or grain such as rice or beans (hereinafter genericly called "fillers"), and the inside of the said tank body 1 is divided with a separating wall 2 horizontally to form an upper chamber 11 and a lower chamber 12. The upper chamber 11 and the lower chamber 12 are in such a state as filled with fillers.

The tank body 1 is a sealed tank, and may be made of either synthetic resin or metal, and more preferably made of a material resistant to corrosion due to the fillers filled with inside. As corrosion resistance can be realized by means of coating, lining, etc, a steel-made tank may also be applicable. The form of crosscut section of the tank body 1 may be multi-angular, round or in any other voluntary shapes.

The fact that the separating wall 2 is movable upward and downward as shown in Figure 1 is important in this invention. In a preferable embodiment of this invention the separating wall 2 consists of a base plate 21 of multi-angular or round form and a slidable sheet 22, and the one end of the said slidable sheet 22 is fixed on an peripheral end of the said base plate 21 and the other end is fixed on the inside walls 13 of the tank body 1.

The base plate 21 consists of a flat board of multi-angular or round form similar to that of the crosscut section of the tank body 1, and its outside diameter is designed to be smaller than the inside diameter of the tank body 1 to provide a given length of the gap between the periphery of the said base plate 21 and the inside wall 13 of the tank body 1.

The material of this base plate 21 may be synthetic resin such as hard vinyl chloride resin or stainless metal, or may be the one surface-coated with vinyl chloride resin or fluorocarbon resin, or a rubber-lined metal.

The slidable sheet 22 is made of chemical-resistant soft synthetic resin such as synthetic polyester resin fiber or synthetic polyethylene resin sheet, and the one end of it is fixed on the periphery of the said base plate 21, and

the other end is fixed on a generally middle part in the vertical direction of the inside walls 13 of the tank body 1.

Also, the slidable sheet 22 is installed to range between the inside walls 13 of the tank body 1 and the periphery of the base plate 21. This makes it possible for the base plate 21 to move up and down within the tank body 1 to ensure that the following two shapes can be taken: a shape in which the space of the upper chamber 11 is the minimum (the state as indicated with dotted lines in Figure 1) when the base plate is located at the highest end and a shape in which the space of the upper chamber 11 is the maximum (the state as indicated with solid lines in Figure 1) when the base plate is located at the lowest end, making it possible to relatively increase and/or decrease the volumes of the upper chamber 11 and the lower chamber 12.

Fillers to be filled with in the tank body 1 include reducing liquids such as sodium sulfite; pH controllers such as caustic soda, sulfuric acid, and calcium hydroxide; chemicals such as polymer coagulant and inorganic coagulant; pressurized liquids such as carbonated beverages, liquids such as drinking water, purified water, and petroleum; fluids including various gases; powders such as flour; or grain such as rice and beans. Among them, reducing liquids can benefit better from the advantage of keeping the fillers away from contacting air as a feature of this invention.

The fillers to be filled with in the upper chamber 11 and the lower chamber 12 may be different each other, but it is more preferable that they are the same, because either of them can be used as a stand-by of the other.

An embodiment in which sodium sulfite (reducing liquid) is filled with in the tank shown in Figure 1 is described as follows: Firstly, sodium sulfite is filled with in the upper chamber 11 through an inlet line 100. Secondly, sodium sulfite is filled with in the lower chamber 12 through an inlet line 200. Thus, the tank body 1 is filled with sodium sulfite.

A pump (not shown in the Figure) connected to an outlet line 201 is actuated, if the sodium sulfite in the lower chamber 12 is used as a pH controller, for example. As the sodium sulfite in the lower chamber 12 is consumed, the separating wall 2 gradually falls, and the volume of the lower chamber 12 relatively decreases. That is, the sodium sulfite in the lower chamber 12 becomes smaller in quantity. On the other hand, the upper chamber 11 is supplemented with sodium sulfite in the same quantity as is decreased in the lower chamber 12. That is, the more the lower chamber 12

loses the filler, the more the upper chamber 11 is supplemented with the filler proportionally.

In this connection, the upper chamber 11 is also equipped with an outlet line 101, through which sodium sulfite in the upper chamber 11 can be discharged.

In the above embodiment, wherein the upper chamber 11 and the lower chamber 12 are kept filled with sodium sulfite, respectively, and sodium sulfite is sent out of the lower chamber 12, the sodium sulfite does not contact air, and therefore there occurs no deterioration due to oxidation.

Also, since the whole tank is filled with the same kind of liquid, the liquid in the upper chamber 11 can be used as a stand-by, if the liquid in the lower chamber 12 has been used up, and no deterioration due to oxidation occurs even during a continuous feeding.

Furthermore, in the above embodiment, the tank is filled with the same kind of liquid, and therefore, there occurs no change in the vertical load of the tank itself even if the liquid is sent out. This is very helpful in designing the foundation of the tank, while the design of the foundation of the tank would be very difficult, if the vertical load fluctuates. In addition, cracks or damage on the foundation of the tank, which is often caused by the fluctuation of the vertical load, can be avoided.

Furthermore, when the liquid in the upper chamber 11 is sent out, the lower chamber 12 is supplemented with the liquid in the same quantity as that sent out from the chamber 11, and therefore, there is no chance to the liquid in the chamber 11 of contacting air, while the liquid in the upper chamber 11 is sent out. Hence, the liquid in the upper chamber 11 can also be continuously sent out without being deteriorated due to oxidation.

When the tank body 1 is filled with liquid as described in the above embodiment, the base plate 21 may be provided with a float (not shown in the Figure) on the upper face and/or lower face, or the base plate 21 itself may be a float. Such a float may be so constituted as to be fed with air from the outside of the tank body 1 to be filled with air, as required.

Also, when the tank body 1 is filled with liquid, the upper chamber 11 or the lower chamber 12 may be equipped with an agitator (not shown in the Figures), as required.

Figure 2 shows another embodiment of the fluid, powder or grain feed tank according to this invention. Explanations of letters or numerals

therein are omitted, since the parts with the same letters or numerals in Figure 2 as in Figure 1 have the same constitution with Figure 1.

The direction of the separating wall 2 within the tank body 1 in this embodiment is upward and downward, and therefore, the separating wall 2 is designed to be movable from side to side. It is without saying that the filler to be filled with may be fluid, powder, or grain, however, a remarkable effect can be obtained when the filler is powder.

That is, hopper-type facilities are typically adopted for feeding powder. The especially important point of hopper type is the tilt angles of the bottom portion of hoppers. If the tilt angles are obtuse, the powder may be hard to fall because the powder gets solid. If the tilt angles are acute, the hopper has to be taller, leading to a higher cost for its installation.

A factor disturbing a smooth powder fall is the contact of the powder with air. This contact cannot be avoided for the hopper-type. As the powder decreases in the hopper, the space in the upper portion of the hopper expands, wherein the powder contacts air and absorbs moisture contained in the air to become apt to form powder blocks. This absorption of moisture disturbs the fall of the powder off the hopper.

If the hopper is sealed, the powder will not fall. The method of feeding dry air into the hopper can be considered, but it would cause an immense installation cost.

In this embodiment, the inside of the tank body 1 is divided with the separating wall 2 into a left chamber 110 and a right chamber 111, and the both chambers are filled with powder, and while the powder is sent out, the powder is kept away from contacting air. This prevents the powder from absorbing the moisture contained in the air to enable a smooth feeding of the powder. There is no invasion of foreign matters, neither. The purpose of making the direction of the separating wall 2 up and down is to prevent the powder from solidification due to compaction.

In each embodiment described above, the tank body 1 is divided into the two chambers by means of fixing the other end of the slidable sheet 22 constituting the separating wall 2 to the inside walls of the tank body 1, but this type of embodiment is not essential, if the tank body 1 can be divided into two chambers in any other way. For example, a slidable sheet may be shaped into a bag and held in the tank body 1, and the inside of the tank body is divided with a boundary part into the part which is inside the bag

and the part which is outside the bag to be called the upper chamber and lower chamber, or the right chamber and the left chamber, as applicable.

Figure 3 and Figure 4 show yet another embodiment of the fluid, powder or grain feed tank according to this invention.

Explanations of letters or numerals in Figure 3 and Figure 4 are omitted, since the parts with the same letters or numerals in Figure 3 and Figure 4 as in Figure 1 have the same constitution with Figure 1.

The tank shown in the present embodiment is common to those described in the other embodiments in that the inside of the tank body 1 is divided into two chambers with a separating wall, which is movable to relatively increase and/or decrease volumes of the chambers, but is characterized in that the two chambers separated each other by the said separating wall are so constituted as to arrange the one chamber around the other chamber.

That is, the tank body 1 assumes a square shape in its cross section, and is provided with a plurality of pillars 3 extended upward and downward inside. The pillars 3 shown in Figure 3 and Figure 4 are four in number, and arranged equally in the four corners within the tank body 1, but their numbers as well as arrangements are not specifically limited.

Each pillar 3 has a separating wall 2 installed on it within the tank body 1. The separating wall 2 is composed of a slidable sheet shaped into a bag state made of chemical-resistant soft synthetic resin such as synthetic polyester resin fiber, synthetic polyethylene resin sheet, or synthetic rubber, and is fixed at its upper part on a filler inlet 14 installed on the upper part of the tank body 1 to allow the said inlet 14 to link only to the inside of the separating wall 2, and is fixed at its lower part on a filler outlet 15 installed on the lower part of the tank body 1 to allow the said outlet 15 to link only to the inside of the separating wall 2, too. And, as shown in Figure 3 and Figure 4, the separating wall 2 is in a state in which the internal volume is the maximum to have the degree of size almost consistent with the inside form of the tank body 1, and is designed to be movable toward an inner chamber 120 and an outer chamber 121 within the tank body 1.

In this embodiment, the inside of the tank body 1 is divided with the separating wall 2 installed on each of the pillars 3 into the two chambers, i.e. the inner chamber 120 formed inside the separating wall 2 and the outer chamber 121 formed between the outer surface of the separating wall 2 and the inside wall of the tank body 1. And the inner chamber 120 is designed

to be able to receive and discharge fillers through an inlet line 14a connected to an inlet 14 and an outlet line 15a connected to an outlet 15, and on the other hand the outer chamber 121 is designed to be able to receive and discharge fillers through an inlet line 16 and an outlet line 17 both installed on a flank of the tank body 1 and linked only to the inside of the said outer chamber 121. 141, 151, 161, and 171 shown in Figure 3 (b) are all open-close valves.

The feed tank shown in this embodiment is thereby designed to be able to relatively increase and/or decrease the volumes of the inner chamber 120 and the outer chamber 121, i.e. maximize the volume of the inner chamber 120 (or minimize the space of the outer chamber 121) by filling it with fillers and gradually decrease the volume of the inner chamber 120 by gradually discharging the fillers from the inner chamber 120 through the outlet line 15a (or gradually sending fillers into the outer chamber 121 through the inlet line 16) and letting the separating wall 2 installed in the spans of the pillars 3 shrink toward the center of the tank body 1 to lead to minimizing the volume of the inner chamber 120 (or maximize the volume of the outer chamber 121).

Since the feed tank shown in this embodiment is provided with the two chambers, i.e. the inner chamber 120 and the outer chamber 121 located around the inner chamber 120, separated by the separating wall 2 within the tank body 1, and variable in relative volume, the fillers filled with can be kept away from deterioration due to oxidation by controlling the sending and discharging of the filler to and from the inner chamber 120 and the outer chamber 121, and there occurs no fluctuation of vertical load of the tank itself, and there is no threat of receiving foreign matters, just as desired in the other embodiments aforementioned in terms of effect.

Also, since the separating wall 2 is installed on the pillars 3 that are arranged within the tank body 1, it can smoothly move toward either the inner chamber 120 or the outer chamber 121 with each pillar 3 as a supporter, and smoothly increase and/or decrease the volumes of the inner chamber 120 and the outer chamber 121.

In the feed tank shown in this embodiment, the inlet line 14a connected to the upper part of the tank body 1 and the outlet line 15 connected to the lower part of the tank body 1 may be arranged oppositely. Furthermore, the inlet line 14a may also act as an outlet line and the outlet line 15a may also

act as an inlet line. In this case, the tank body 1 may be provided with only any one of the inlet line 14a and the outlet line 15a.

The pillars 3 hanging the separating wall 2 may be arranged not only on the four corners inside the tank body 1 as shown in Figure 3 and Figure 4, but also on a generally central parts of the four sides of the inside of the tank body 1 having square cross section as shown in Figure 5 (a). In this case, if the separating wall 2 in the spans of the pillars 3 shrinks at the most toward the center of the tank body 1, the inner faces of the separating wall 2 in the spans of the pillars 3 contacts closely together to make the volume of the inner chamber 120 the minimum, and the volume of the outer chamber 121 the maximum.

The form of the cross section of the tank body 1 is not limited to square, but can be another polygon such as triangle or pentagon, and the number of the pillars 3 on which the separating wall 2 is installed may be appropriately adjusted in conformity with the shape of the tank body 1.

Furthermore, the tank body 1 may be a circle in cross section as shown in Figure 6 (a) and (b). Figure 6 (a) and Figure 6 (b) show the state of the maximized volume of the inner chamber 120 and the state of the maximized volume of the outer chamber 121, respectively.

For this third embodiment the fillers to be filled with in the tank body 1 may be sludge (activated sludge, coagulated sludge, etc) to be sedimented and separated besides fluid, powder, or grain as already exemplified.

The fluid, powder or grain feed tank according to this invention as aforementioned can take other various kinds of embodiments according to its uses in addition to the embodiments as merely ordinary tanks. For example, the fluid, powder or grain feed tank according to this invention can take the embodiment of cargo ships as shown in Figure 7.

Figure 7 shows that a space to be filled with fillers is formed within a region surrounded by side walls 10A, an upper wall 11A, and a bottom wall 12A. This space is equipped with a separating wall 13A formed by a slidable sheet similar to those aforementioned and movable up and down, and this separating wall 13A is designed to separate an upper chamber 14A and a lower chamber 15A, and also be able to relatively increase and/or decrease the volumes of the upper chamber 14A and the lower chamber 15A through inlets and outlets (not shown in Figure 7) by moving up and down. This slidable sheet is formed into a bag state, and fixed at its peripheral part

on the side walls around the generally middle part of the space to form the lower chamber 15A inside the bag and the upper chamber 14A outside the bag, and the slidable sheet corresponding to a boundary part between the upper chamber 14A and the lower chamber 15A is designed to act as the separating wall 13A and be movable up and down.

Figure 7 shows that the separating wall 13A is not equipped with a part corresponding to the base plate 21 shown in Figure 1, and constituted only by the slidable sheet. In case there is no base plate, as exemplified in this embodiment, the separating wall 13A is preferably formed to have a size such that when the volume of the upper chamber 14A or the lower chamber 15A is maximized the separating wall 13A can almost closely stick to the wall of the other chamber so that each of the upper chamber 14A and the lower chamber 15A can be utilized to the maximum.

This embodiment realizes the holding and transportation of fillers, keeping them away from deterioration due to oxidation or the threat of invasion by foreign matters, since the fillers are held in the lower chamber 15A, as shown in the said Figure, for example. If the fillers held in the lower chamber 15A are sent out from the ship, keeping this state as it is, then the inside is rendered empty. For cargo ships, it is required that the empty space must be filled with ballast water (sea water). In the present case, filling of the upper chamber 14A with water will keep the draft at a given level, and in addition, does not cause a problem of contaminating the lower chamber 15A with the ballast water, since the upper chamber 14A is perfectly isolated from the lower chamber 15A with the separating wall 13A.

Also, since the separating wall 13A is movable up and down within the ship, there is no risk of endangering the ship balance.

Furthermore, when either chamber is constituted by a bag-state slidable sheet, leak of fillers held in the chamber formed by the bag-state sheet will be prevented even in the event of wreckage and occurrence of rifts in the hull. If the filler is petroleum in the chamber formed by this bag-state slidable sheet, the problem of ocean contamination due to oil leak in case of wreckage will vanish.

Industrial applicability of the invention

This invention is able to provide fluid, powder or grain feed tank, wherein fillers do not develop deterioration due to oxidation, do not develop